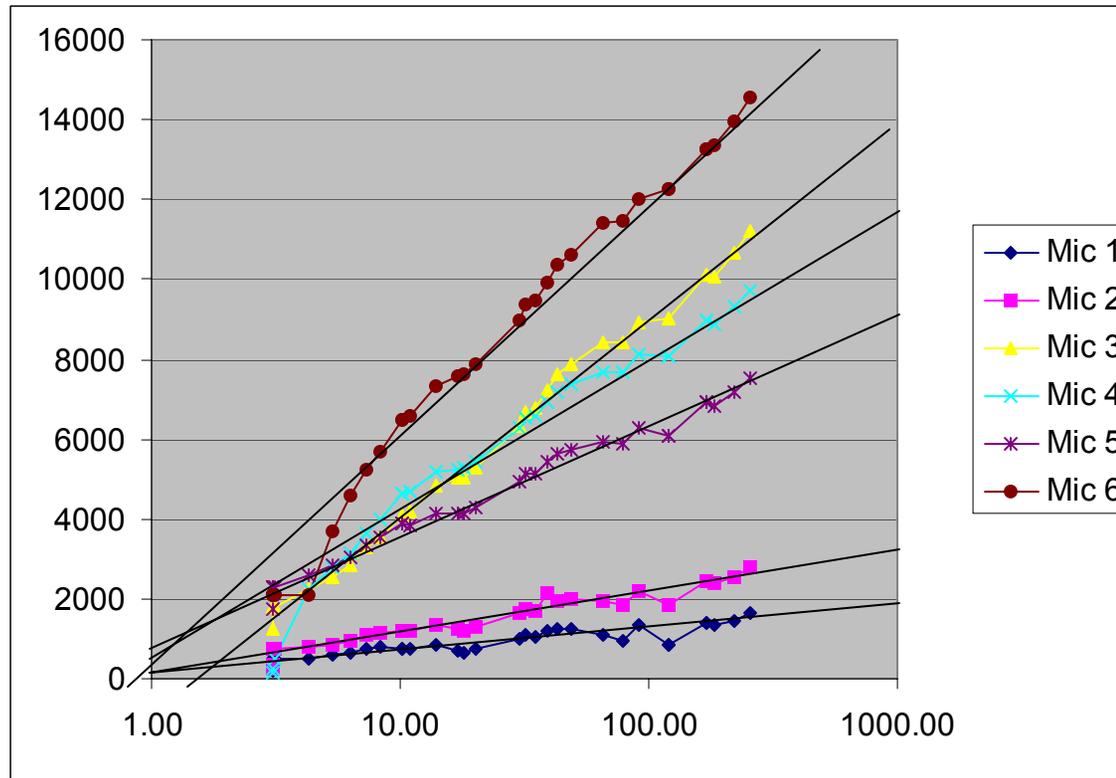


We present about one year's worth of creep data

on PVC cut from a commercial car wash door extrusion made by Extrutech..

Creep can be well represented so far by a logarithmic time dependence.



Time dependence of sample elongation under stress.

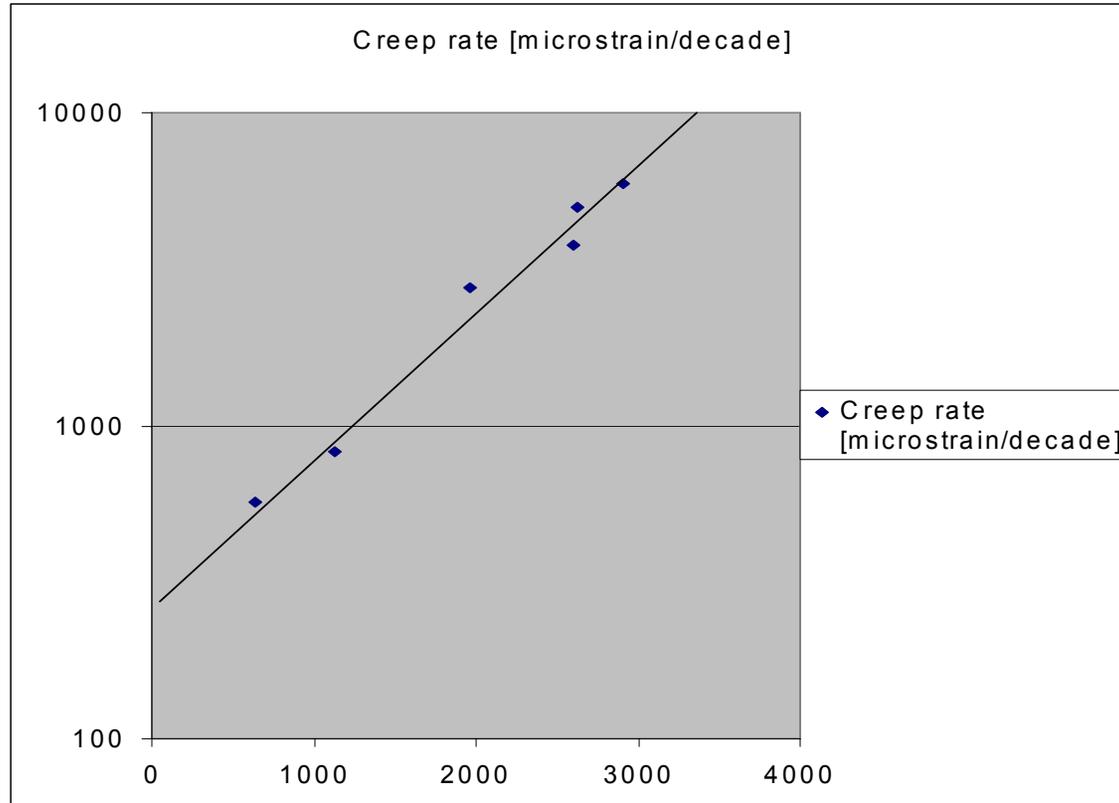
Data are shown in units of “Microstrain” (ppm elongation) versus time in days.

The rate of creep is consistent with being exponentially dependent on the stress.

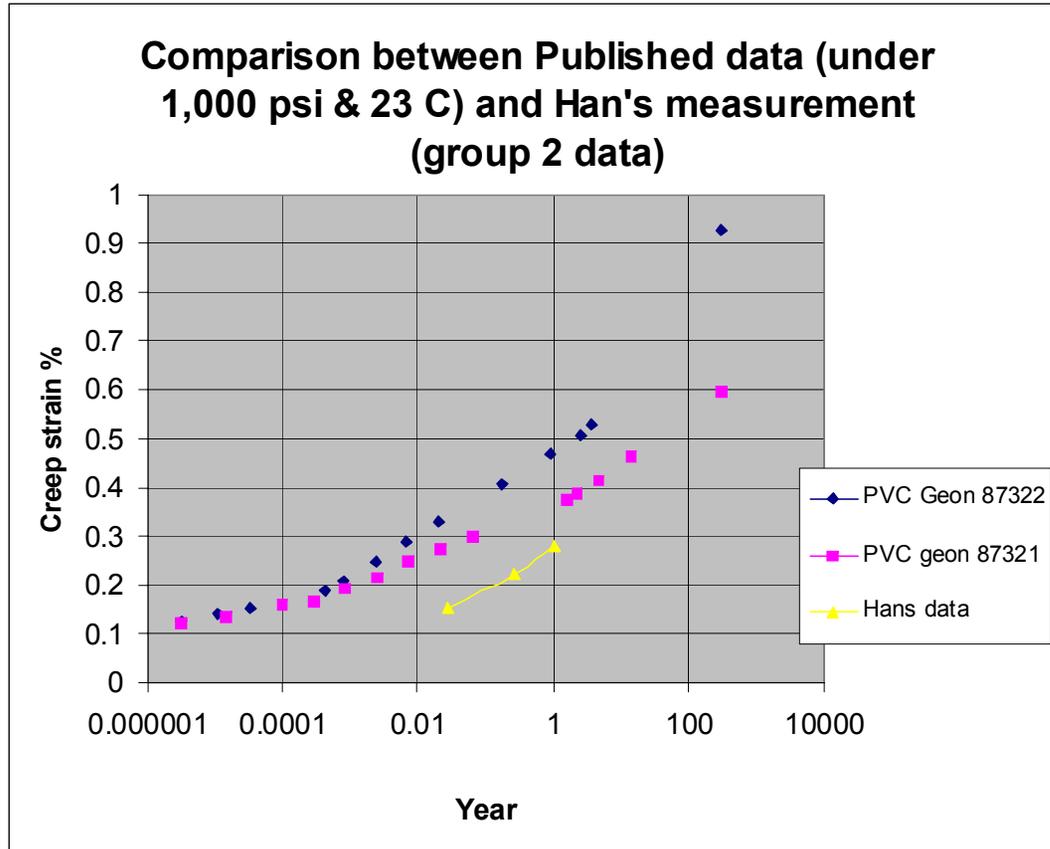
Creep Rate Versus Stress

: The creep rates in Fig. 2 were approximated as simple exponentials (by hand; not shown in the figure) for the data beyond day 3 or so.

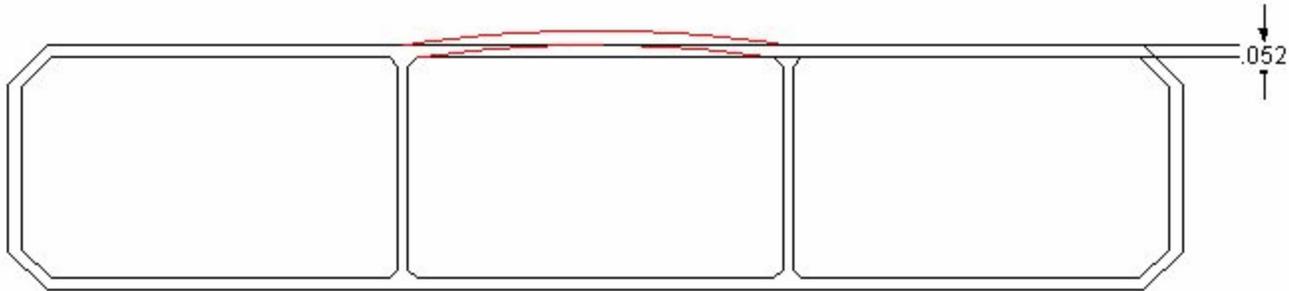
The rates are approximately an exponential function of the stress.



Published PVC Creep Rates vs. our Data



Published creep rates are similar, but about 30% higher .
Log response holds (more or less) for very long times..
We will measure creep and Modulus for “our” PVC



NOVA 3-cell test extrusion as produced
and as deformed by a 72 psi test

We relate those creep results to allowable design stress and strain in PVC

Using this example as an “acceptable deformation”,

Hans Jostlein 4/51/2005

We go back and calculate an “acceptable strain”,

Yielding acceptable creep rate and hence stress.

The result is 1466 psi, based on the PVC Extrutech sample we measured.

Creep Effects on block swelling

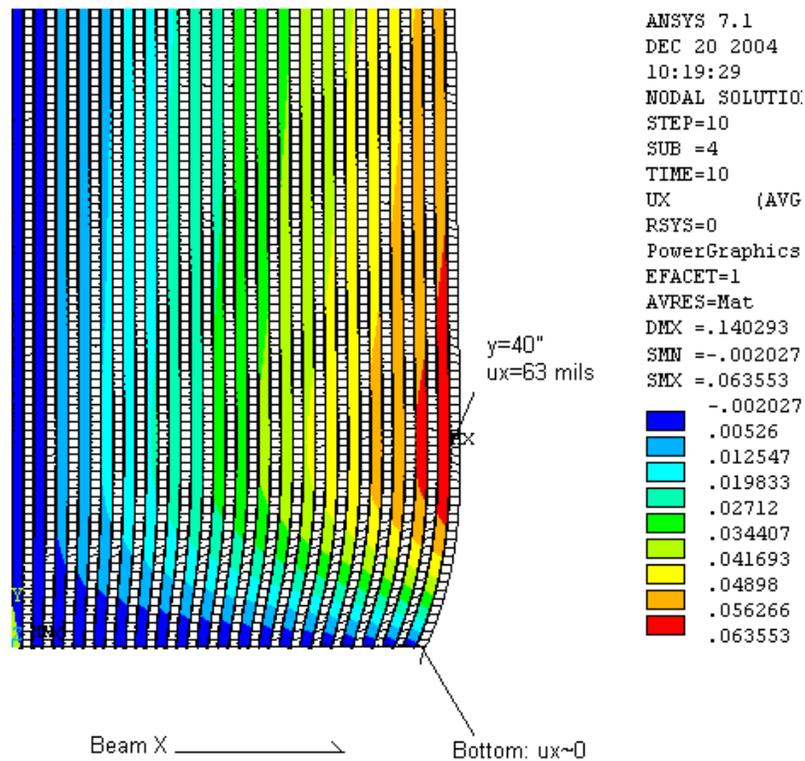
In a nutshell, the deformation increases over time due to creep.

At the same time the stresses are reduced, again due to creep.

Nature, for once helps here: the highest stressed points in the structure relax their stresses the fastest.

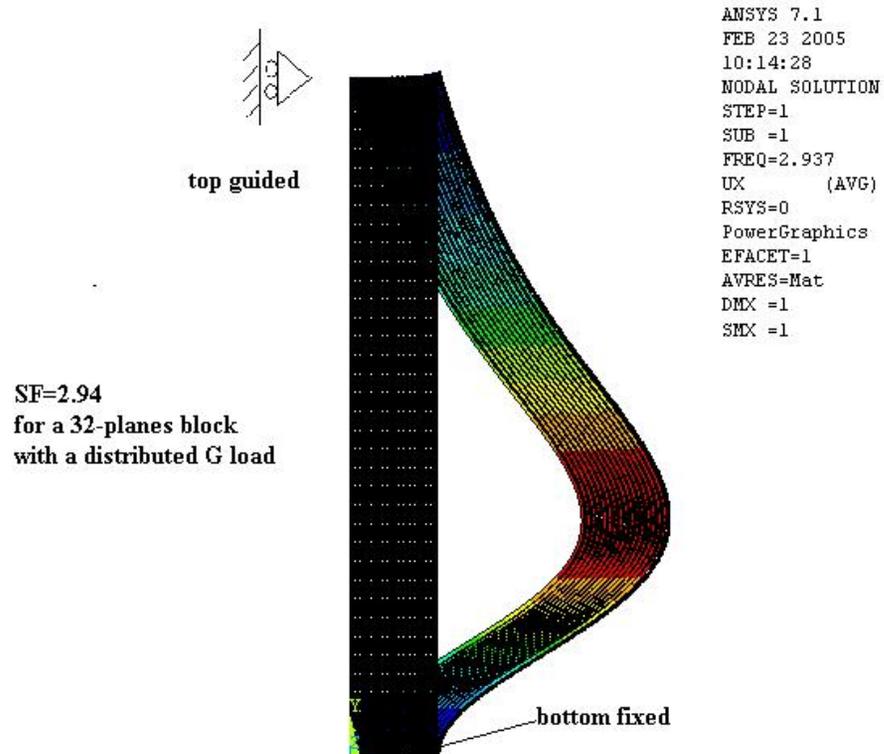
A detailed model calculation remains to be done to confirm the details.

Expectation: 32-plane blocs remain acceptable.



Displacement along X direction for the case of the 40 planes filled

32-planes buckling calculation for a distributed G load (top guided)



Note: Buckling stability safety factor is not affected by Creep.

So, What is the Design these Days ?

→ Nothing Has Changed ←

The Front wall of the building serves as the first Bookend.

The detector is built in 8-plane blocks that are raised and attached to the existing detector planes to form 32-plane blocks.

At that point an air gap is provided using a top and bottom spacer.

The airgap accommodates the swelling of the block from oil pressure, due to elastic and to creep deformation.

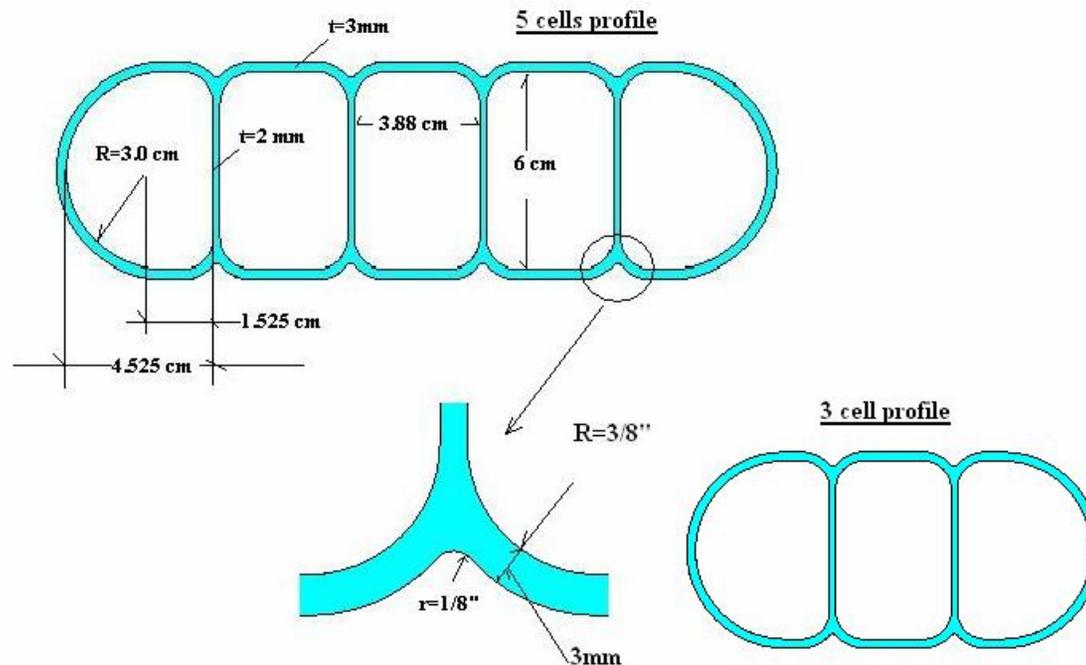
32-plane blocks are stable against buckling.

We know its works.

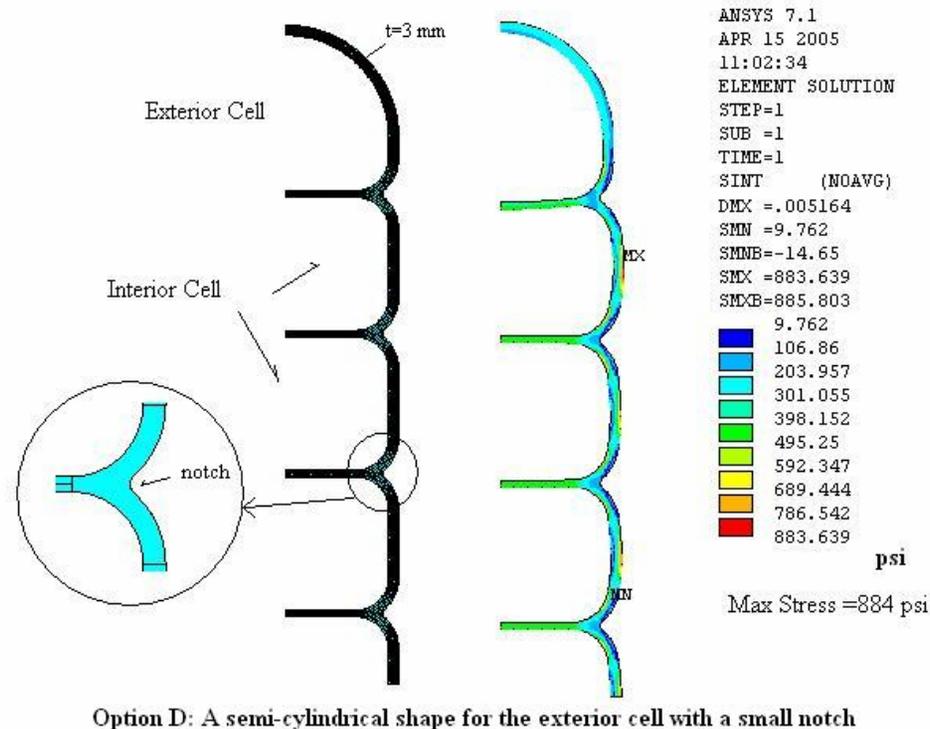
Detail Design work and dimensioning is yet to be done.

We propose a cell profile with rounded corners that reduces the stress in the PVC drastically

We also show a shape for the outermost cell in vertical planes



Stresses in the Rounded Cell Shape



The Maximum Stress is now well below 1000 psi
We are no longer relying on X-Y plane gluing to manage stresses.

Pressure Testing and Creep

Creep is fastest when stress is first applied.

The 3-cell sample was exposed to 72 psi for just a couple of minutes, and bowed visibly.

We think we need to pressure test all extrusions to perhaps well above the 20psi service pressure, to eliminate defective extrusions.

Extrusions may deform permanently during this test.

This is not all bad.

It imprints on the material a pre-creep, which will reduce subsequent creep deformation.

Example: Plastic strapping is made of Polypropylene, pre-extended by 40 %, to avoid creep during service.

A Second Bookend ?

Needed for cosmics ?

Not Obvious.

Photons would go the wrong way after entering the back face of the detector

Can serve double duty as “ultimate protection”

We can design air gaps to accept elastic swelling and creep swelling of the blocks (with 2x safety factor)

If swelling or creep should be much larger, a second bookend will constrain the detector.

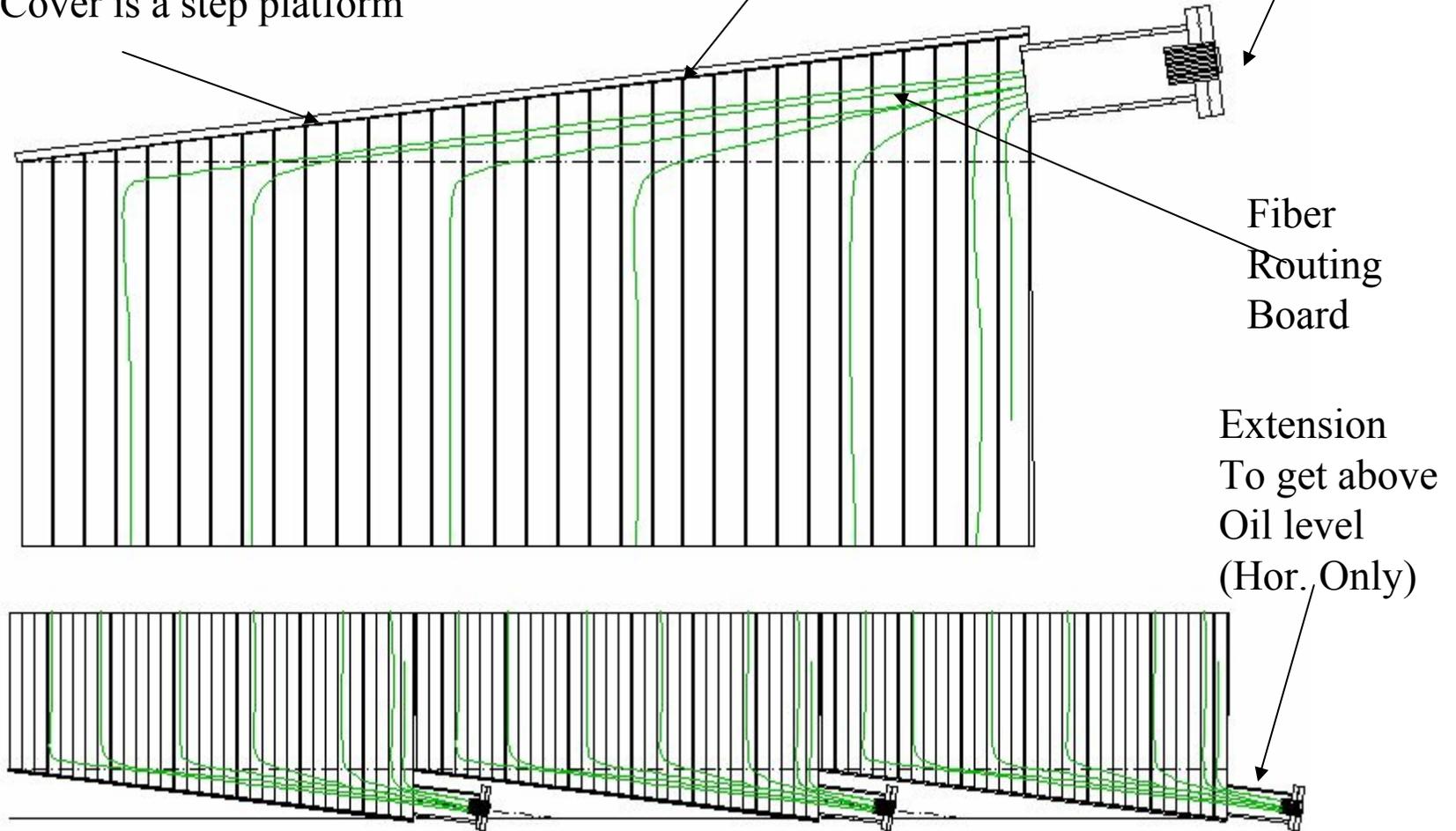
With proper design, this should not be needed.

Snout Design

Cover is a step platform

Cover gets glued on last

Electronics



Fiber
Routing
Board

Extension
To get above
Oil level
(Hor. Only)